

Math Mosaic Circles

Group "Johnson"

Name: _____

Part I – use the +, -, x signs and parentheses and the numbers 1, 3, 4, 6 to get each of the numbers 1 through 23. Numbers can be used in any order – like in the game “24”. You can write down your solutions as you figure them out. Use the list below to cross off the results that you already found. Complete as many as you can.

1	2	3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22	23	

<u>Example:</u> $(6-1) \times (4-3) = 5$	
<u>Example:</u> $6 \times 4 - 3 - 1 = 20$	

Part II – Logic problems

1. A boy and a girl are sitting next to each other. "I am a boy" - says the dark-haired child. "I am a girl!", says the red-haired child. Find out the color of the boy's and girl's hair if it is known that at least one child is not telling the truth.
2. Thirty children came to a party. Out of any 12 of them, at least one is a boy. Out of any 20 of them, at least one is a girl. How many boys and how many girls are there at this party?
3. Max has three talking parrots: Polly, Dolly and Archie. We know that one of Max's parrots never tells the truth, and another one never lies. The third parrot is a trickster: this bird sometimes lies and sometimes tells the truth. Bella is visiting Max. She asks each parrot: "Who are you?"
 - "I am a liar!" declares Polly.
 - "I am a trickster!" pronounces Dolly.

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- "I am absolutely honest!" states Archie.
How can Bella figure out who is the liar and who is the trickster?

- 4. While visiting the Island of Knights and Liars, you meet a local boy. What should you ask him if you want to find out whether he is a knight or a liar?

- 5. Emma and Rachel are from the Island of Knights and Liars. One of them is a liar and the other is a knight. Emma claims that 2 rubies are more expensive than 3 sapphires. Rachel says that 3 rubies are more expensive than 4 sapphires. Is it the case that 12 rubies are more expensive than 18 sapphires?

- 6. 6 sharks weigh less than 5 whales, but more than 10 dolphins. All sharks weigh the same, as do all dolphins. Would 2 sharks be heavier than 3 dolphins or the other way around?

- 7. On the Island of Knights and Liars, knights and liars live in separate villages. However, they often visit their friends in other villages. This week, the island newspaper announced a contest: to come up with a single yes/no question that would allow a tourist to figure out whether he is in a knights' village or in a liars' village. The question should be such that it can be addressed to anyone the tourist sees. It is not known in advance whether this local is a knight or a liar and whether he is a resident of this village or not. Johnny the Math Circle Student won the prize. What was his question?

Hint: fill out the table below with the answers you would get for any question you want to try out.



	<u>If you're in knights' village</u>	<u>If you are in liars' village</u>
<u>If the person is a knight</u>		
<u>If the person is a liar</u>		

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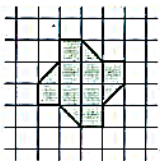
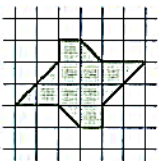
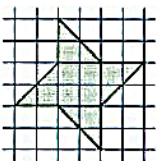
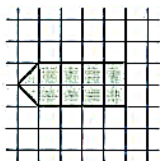
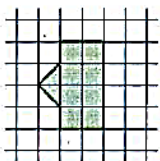
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Part III – complete the practice Kangaroo problems.

2. In four of the five pictures below the white area is equal to the grey area. In which picture are the white area and the grey area different?

- A)  B)  C)  D)  E) 

9. Which of the figures below has the greatest area?

- A)  B)  C)  D)  E) 

21. Cristi has to sell 10 glass bells which vary in price: 1 dollar, 2 dollars, 3 dollars, 4 dollars, 5 dollars, 6 dollars, 7 dollars, 8 dollars, 9 dollars, and 10 dollars. In how many ways can Cristi divide all the glass bells into three packages so that each the packages has the same price?

- (A) 1 (B) 2 (C) 3 (D) 4
 (E) Such a division is not possible.

23. A rectangular paper sheet measures 192×84 mm. You cut the sheet along just one straight line to get two parts, one of which is a square. Then you do the same with the non-square part of the sheet, and so on. What is the length of the side of the smallest square you can get with this procedure?

- A) 1 mm B) 4 mm C) 6 mm D) 10 mm E) 12 mm